CLAIMS:

1. A composition of matter comprising a hydride ion having a binding energy greater than 0.8 eV.

2. A composition of claim 1 wherein the binding energy is about 3 eV.

3. A composition of claim 1 wherein the binding energy is about 7 eV.

4. A composition of claim 1 wherein the binding energy is about 11 eV.

5. A composition of claim 1 wherein the binding energy is about 17 eV.

6. A composition of claim 1 wherein the binding energy is about 23 eV.

7. A composition of claim 1 wherein the binding energy is about 29 eV.

8. A composition of claim 1 wherein the binding energy is about 36 eV.

9. A composition of claim 1 wherein the binding energy is about 43 eV.

10. A composition of claim 1 wherein the binding energy is about 49 eV.

11. A composition of claim 1 wherein the binding energy is about 55 eV.

12. A composition of claim 1 wherein the binding energy is about 61 eV.

13. A composition of claim 1 wherein the binding energy is about 66 eV.

14. A composition of claim 1 wherein the binding energy is about 69 eV.

15. A composition of claim 1 wherein the binding energy is about 71 eV.

16. A composition of claim 1 wherein the binding energy is about 72 eV.

17. A composition of matter comprising a compound comprising at least one increased binding energy hydrogen species selected from the group consisting of:

an increased binding energy hydride ion having a binding energy greater than 0.8 eV,

an increased binding energy hydrogen atom having a binding energy of about $13.6/n^2$ eV,

an increased binding energy hydrogen molecule having a first binding energy of about $15.5/n^2$ eV, and

an increased binding energy molecular hydrogen ion having a first binding energy of about $16.4/n^2$ eV,

wherein n is a fraction whose numerator is 1 and denominator is an integer greater than 1.

18. A composition of claim 17 wherein the compound further comprises one or more cations.

19. A composition of claim 18 wherein the cation is a proton.

20. A composition of claim 18 wherein the cation is the ion H_3^+.

21. A composition of claim 17 wherein the compound further comprises one or more normal hydrogen atoms.

22. A composition of claim 17 wherein the compound further comprises one or more normal hydrogen molecules.

23. A composition of claim 17 wherein the compound has a formula selected from the group of formulae consisting of MH, MH_2, and M_2H_2 wherein M is an alkali cation and H is selected from the group consisting of said increased binding energy hydride ion and said increased binding energy hydrogen atom.

24. A composition of claim 17 wherein said compound has the formula MH_n wherein n is 1 or 2, M is an alkaline earth cation and H is selected from the group consisting of said increased binding energy hydride ion and said increased binding energy hydrogen atom.

25. A composition of claim 17 wherein the compound has the formula MHX wherein M is an alkali cation, X is one of a neutral atom, a molecule, or a singly negatively charged anion, and H is selected from the group consisting of said increased binding energy hydride ion and said increased binding energy hydrogen atom.

26. A composition of claim 17 wherein the compound has the formula MHX wherein M is an alkaline earth cation, X is a single negatively charged anion, and H is selected from the group consisting of said increased binding energy hydride ion and said increased binding energy hydrogen atom.

27. A composition of claim 17 wherein the compound has the formula MHX wherein M is an alkaline earth cation, X is a doubly negatively charged anion, and H is

said increased binding energy hydrogen atom.

28. A composition of claim 19 wherein said compound has the formula M_2HX where M is an alkali cation, X is a singly negatively charged anion, and H is selected from the group consisting of said increased binding energy hydride ion and said increased binding energy hydrogen atom.

29. A composition of claim 17 wherein the compound has the formula MH_n wherein n is an integer from 1 to 5, M is an alkaline cation and the hydrogen content H_n of said compound comprises at least one said increased binding energy hydrogen species.

30. A composition of claim 17 wherein the compound has the formula M_2H_n wherein n is an integer from 1 to 4, M is an alkaline earth cation and the hydrogen content H_n of said compound comprises at least one said increased binding energy hydrogen species.

31. A composition of claim 17 wherein the compound has the formula M_2XH_n wherein n is an integer from 1 to 3, M is an alkaline earth cation, X is a singly negatively charged anion, and the hydrogen content H_n of said compound comprises at least one said increased binding energy hydrogen species.

32. A composition of claim 17 wherein the compound has the formula $M_2X_2H_n$ wherein n is 1 or 2, M is an alkaline earth cation, X is a singly negatively charged anion, and the hydrogen content H_n of said compound comprises at least one said increased binding energy hydrogen species.

33. A composition of claim 17 wherein the compound has the formula M_2X_3H wherein M is an alkaline earth cation, X is a singly negatively charged anion, and H is selected from the group consisting of said increased binding energy hydride ion and said increased binding energy hydrogen atom.

34. A composition of claim 17 wherein the compound has the formula M_2XH_n wherein n is 1 or 2, M is an alkaline earth cation, X is a doubly negatively charged anion, and the hydrogen content H_n of said compound comprises at least one said increased binding energy hydrogen species.

35. A composition of claim 17 wherein the compound has the formula $M_2XX'H$ wherein M is an alkaline earth cation, X is a singly negatively charged anion, X' is a doubly negatively charged anion, and H is selected from the group consisting of said increased binding energy hydride ion and said increased binding energy hydrogen atom.

36. A composition of claim 17 wherein the compound has the formula $MM'H_n$ wherein n is an integer from 1 to 3, M is an alkaline earth cation, M' is an alkali metal cation, and the hydrogen content H_n of said compound comprises at least one said increased binding energy hydrogen species.

37. A composition of claim 17 wherein said compound is $MM'XH_n$ wherein n is 1 to 2, M is an alkaline earth cation, M' is an alkali metal cation, X is a singly negatively charged anion, and the hydrogen content H_n of said compound comprises at least one said increased binding energy hydrogen species.

38. A composition of claim 17 wherein said compound is MM'XH where M is an alkaline earth cation, M' is an alkali metal cation, X is a doubly negatively charged anion, and H is selected from the group consisting of said increased binding energy hydride ion and said increased binding energy hydrogen atom.

39. A composition of claim 17 wherein the compound has the formula MM'XX'H wherein M is an alkaline earth cation, M' is an alkali metal cation, X and X' are each a singly negatively charged anion, and H is selected from the group consisting of said increased binding energy hydride ion and said increased binding energy hydrogen atom.

40. A composition of claim 17 wherein the compound has the formula H_nS wherein n is 1 or 2, and the hydrogen content H_n of said compound comprises at least one said increased binding energy hydrogen species.

41. A composition of claim 17 wherein the compound has the formula $MSiH_n$ wherein n is an integer from 1 to 6, M is an alkali or alkaline earth cation, and the hydrogen content H_n of said compound comprises at least one said increased binding energy hydrogen species.

42. A composition of claim 17 wherein the compound has the formula $MXX'H_n$

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wherein

n is an integer from 1 to 5;

M is an alkali or alkaline earth cation;

X is a singly negatively charged anion or a doubly negative charged anion;

X' is selected from the group consisting of Si, Al, Ni, the transition elements, the inner transition elements, and the rare earth elements; and

the hydrogen content H_n of said compound comprises at least one said increased binding energy hydrogen species.

43. A composition of claim 17 wherein the compound has the formula $MAlH_n$ wherein n is an integer from 1 to 6, M is an alkali or alkaline earth cation, and the hydrogen content H_n of said compound comprises at least one said increased binding energy hydrogen species.

44. A composition of claim 17 wherein the compound has the formula MH_n wherein:

n is an integer from 1 to 6;

M is selected from the group consisting of the transition elements, the inner transition elements, rare earth element cations and nickel; and

the hydrogen content H_n of said compound comprises at least one said increased binding energy hydrogen species.

45. A composition of claim 17 wherein the compound has the formula $MNiH_n$ wherein:

n is an integer from 1 to 6;

M is selected from the group consisting of alkali cations, alkaline earth cations, silicon, and aluminum; and

the hydrogen content H_n of said compound comprises at least one said increased binding energy hydrogen species.

46. A composition of claim 17 wherein the compound has the formula MXH_n wherein:

n is an integer from 1 to 6;

M is selected from the group consisting of alkali cations, alkaline earth cations, silicon, and aluminum;

X is selected from the group consisting of the transition elements, the inner transition elements, and rare earth element cations; and

the hydrogen content H_n of said compound comprises at least one said increased binding energy hydrogen species.

47. A composition of claim 17 wherein the compound has the formula M_2SiH_n wherein n is an integer from 1 to 8, M is an alkali or alkaline earth cation, and the hydrogen content H_n of said compound comprises at least one said increased binding energy hydrogen species.

48. A composition of claim 17 wherein the compound has the formula Si_2H_n wherein n is an integer from 1 to 8, and the hydrogen content H_n of said compound comprises at least one said increased binding energy hydrogen species.

49. A composition of claim 17 wherein the compound has the formula SiH_n wherein n is an integer from 1 to 8 and the hydrogen content H_n of said compound comprises at least one said increased binding energy hydrogen species.

50. A composition of claim 17 wherein the compound has the formula TiH_n wherein n is an integer from 1 to 4 and the hydrogen content H_n of said compound comprises at least one said increased binding energy hydrogen species.

51. A composition of claim 17 wherein said compound has the formula Al_2H_n wherein n is an integer from 1 to 4 and the hydrogen content H_n of said compound comprises at least one said increased binding energy hydrogen species.

52. A composition of claim 17 wherein the compound has the formula $MXAlX'H_n$ wherein n is 1 or 2, M is an alkali or alkaline earth cation, X and X' are each either a singly negatively charged anion or a doubly negative charged anion, and the hydrogen content H_n of said compound comprises at least one said increased binding energy hydrogen species.

53. A composition of claim 17 wherein the compound has the formula $MXSiX'H_n$ wherein n is 1 or 2, M is an alkali or alkaline earth cation, X and X' are each either a singly negatively charged anion or a doubly negatively charged anion, and the hydrogen content H_n of said compound comprises at least one said increased binding energy hydrogen species.

54. A composition of claim 17 wherein the compound has the formula SiO_2H_n wherein n is an integer from 1 to 6 and the hydrogen content H_n of said compound comprises at least one said increased binding energy hydrogen species.

55. A composition of claim 17 wherein said the compound has the formula $MSiO_2H_n$ wherein n is an integer from 1 to 6, M is an alkali or alkaline earth cation, and the hydrogen content H_n of said compound comprises at least one said increased binding energy hydrogen species.

56. A composition of claim 17 wherein the compound has the formula MSi_2H_n wherein n is an integer from 1 to 6, M is an alkali or alkaline earth cation, and the hydrogen content H_n of said compound comprises at least one said increased binding energy hydrogen species.

57. A composition of claim 17 wherein the compound has the formula M_2SiH_n wherein n is an integer from 1 to 8, M is an alkali or alkaline earth cation, and the hydrogen content H_n of said compound comprises at least one said increased binding energy hydrogen species.

58. A composition of any of claims 25, 26, 28, 31, 32,33, 35, 37, 39, 42, and 52 wherein said singly negatively charged anion is selected from the group consisting of halogen ion, hydroxide ion, hydrogen carbonate ion, and nitrate ion.

59. A composition of any of claims 27, 34, 35, 38, 42, and 52 wherein said doubly negative charged anion is elected from the group consisting of carbonate ion and sulfate ion.

60. A composition of claim 17 wherein said compound is greater than 50 atomic percent pure.

61. A composition of claim 60 wherein said compound is greater than 90 atomic percent pure.

62. A method for preparing a compound comprising at least one increased binding energy hydrogen species selected from the group consisting of an increased binding energy hydride ion having a binding energy greater than 0.8 eV, an increased binding energy hydrogen atom having a binding energy of about $13.6/n^2$ eV, an increased binding energy hydrogen molecule having a first binding energy of about $15.5/n^2$ eV, and an increased binding energy molecular hydrogen ion having a first binding energy of about $16.4/n^2$ eV, wherein n is a fraction whose numerator is 1 and denominator is an integer greater than 1, the method comprising:

reacting atomic hydrogen by use of a catalyst having a net enthalpy of reaction of at least m27 eV, where m is an integer, to produce an atomic hydrogen having a binding energy of about $13.6/n^2$ eV, wherein n is a fraction whose numerator is 1 and denominator is an integer greater than 1,

reacting said produced atomic hydrogen with an electron, to produce a hydride ion having a binding energy greater than 0.8 eV, and

reacting said produced hydride ion with one or more cations, thereby producing said compound.

63. A method of claim 62 further comprising the step of isolating said compound to be substantially pure.

64. A method for preparing a compound comprising at least one increased binding energy hydride ion having a binding energy greater than 0.8 eV, the method comprising:

reacting atomic hydrogen by use of a catalyst having a net enthalpy of reaction of at least m27 eV, where m is an integer, to produce an atomic hydrogen having a binding energy of about $13.6/n^2$ eV, wherein n is a fraction whose numerator is 1 and denominator is an integer greater than 1,

reacting said produced atomic hydrogen with an electron, to produce a

hydride ion having a binding energy greater than 0.8 eV, and

reacting said produced hydride ion with one or more cations, thereby producing said compound.

add A'

add D'